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## **SEAWEED RESEARCH AND UTILIZATION IN INDIA**

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## THREE

### KEY FOR IDENTIFICATION OF ECONOMICALLY IMPORTANT SEAWEEDS

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The design of keys for identification of algae is based on the external form with addition of obvious cytological details. Form alone can be used for large thalloid algae. Form combined with pigmentation and chromatophore shape can lead to the identification of

many algae. It is often necessary to examine the apex of branches to determine the manner of growth. It will be worthwhile to take particular notice of the apices of branches in the red algae since the characteristics of the apex will provide important clues for

identification in that group. In many instances, the kind of attachment of seaweed to the substratum is an important generic or specific character and identification may be impossible without a knowledge of it. Unlike the several seed-bearing marine flowering plants, the algae reproduce, with few exceptions, by means of microscopic spores. Although these spores are very small, the reproductive structures which produce them are often large

enough to be visible to the naked eye and are useful in providing distinctive characters for identification purposes. The habitat of the alga, i.e. marine or freshwater, may be of value in identification, but is not a reliable taxonomic character. A key for identification of the economically important genera and species of green, brown and red seaweeds listed in the previous chapter is given below. The external and internal characters of the plants are used in the preparation of this key.

## GREEN ALGAE

### Key to Genera and Species

- |                                                                                                                                                             |                                   |       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-------|
| 1. Plants multicellular, main fronds and branches consisting of small cells                                                                                 | .....                             | 2     |
| 1. Plants non-cellular, coenocytic                                                                                                                          | .....                             | 3     |
| 2. Plants unbranched with one-cell thick cell rows, filamentous, brush like, attached by long basal cells with constrictions                                | ... <i>Chetomorpha antennina</i>  | (1)   |
| 2. Plant branched, not filamentous                                                                                                                          | .....                             | 4     |
| 3. Plants differentiated into roots, horizontal stems and erect foliar elements, branched filaments or trabeculae arising from the inner wall of the fronds | ... <i>Caulerpa</i>               | (I)   |
| 3. Plants erect or prostrate with interwoven filaments and enlarged sac-like structures or utricles                                                         | ... <i>Codium</i>                 | (II)  |
| 4. Adult plants usually tubular with one-cell-thick membrane, more or less compressed, profusely branched at the basal parts                                | ... <i>Enteromorpha compressa</i> | (2)   |
| 4. Adult plants not tubular, flat, foliaceous and thallus two-cell thick                                                                                    | ... <i>Ulva</i> spp.              | (III) |

#### I. Key to Species of *Caulerpa*

- |                                                                                                                                |                              |   |
|--------------------------------------------------------------------------------------------------------------------------------|------------------------------|---|
| 1. Erect fronds with much crowded branchlets arising from all sides, branchlets swollen sub-spherical, with or without a stalk | ... <i>C. racemosa</i>       |   |
| 1. Erect fronds with branchlets in two rows                                                                                    | .....                        | 2 |
| 2. Branchlets flat, constricted at the base and sickle-shaped                                                                  | ... <i>C. taxifolia</i>      |   |
| 2. Branchlets cylindrical with pointed tips and closely arranged in the form of a feather                                      | ... <i>C. sertularioides</i> |   |

#### II. Keys to the species of *Codium*

- |                                                                                                                      |                            |   |
|----------------------------------------------------------------------------------------------------------------------|----------------------------|---|
| 1. Plants prostrate with irregularly lobed and spongy thallus, utricles 50-70 $\mu$ and rarely 100 $\mu$ in diameter | ... <i>C. adharens</i>     |   |
| 1. Plants erect and repeatedly branched                                                                              | .....                      | 2 |
| 2. Plants cylindrical, dichotomously branched and utricles 150-200 $\mu$ broad                                       | ... <i>C. tomentosum</i>   |   |
| 2. Plants compressed, flattening very conspicuous near the forks, utricles 300-500 $\mu$ broad                       | ... <i>C. docorticatum</i> |   |

### III. Key to the Species of *Ulva*

- |                                                                                                                 |                          |
|-----------------------------------------------------------------------------------------------------------------|--------------------------|
| 1. Plants with reticulate or net-like fronds or profusely perforated, often grow inter-mingled with other algae | ... <i>U. reticulata</i> |
| 1. Plants variously shaped and attached to rocks with definite holdfasts                                        | ..... 2                  |
| 2. Fronds delicate, grow as large sheets, cells square or slightly elongated in sectional view of the thallus   | ... <i>U. lactuca</i>    |
| 2. Cells distinctly elongated in sectional view of the thallus                                                  | ..... 3                  |
| 3. Fronds firm and stiff with a distinct holdfast and short cylindrical stipe, usually divided into broad lobes | ... <i>U. rigida</i>     |
| 3. Thallus divided into narrow ribbon-like lobes (0,5 - 2.5 cm broad) with pale green central portion           | ... <i>U. fasciata</i>   |

### BROWN ALGAE

#### Key to the Genera and Species

- |                                                                                                                                                                                                                                                                                                            |                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| 1. Plants large with leaf-like, stem-like and organs and vesicles or air bladders                                                                                                                                                                                                                          | ..... 2                             |
| 1. Plants small with different shapes of thalli                                                                                                                                                                                                                                                            | ..... 3                             |
| 2. Vesicles or air bladders immersed in the leaves or branches                                                                                                                                                                                                                                             | ..... 4                             |
| 2. Vesicles or air bladders not immersed in the leaves                                                                                                                                                                                                                                                     | ..... 5                             |
| 4. Fronds angular, winged, compressed, often spinulose and irregularly branched                                                                                                                                                                                                                            | ... <i>Hormophysa triquetra</i>     |
| 4. Plants attached by branching haptera with turbinate or obconical leaves                                                                                                                                                                                                                                 | ... <i>Turbinaria</i> (I)           |
| 5. Vesicles or air bladders single                                                                                                                                                                                                                                                                         | ... <i>Sargassum</i> (II)           |
| 5. Vesicles seriate with beaded appearance, stems covered with short processes giving muricated appearance                                                                                                                                                                                                 | ... <i>Cystophyllum muricatum</i>   |
| 3. Plants flat with terminal growth, often 2-4 cells thick, cells regularly arranged in sectional view                                                                                                                                                                                                     | ..... 6                             |
| 3. Plants not flat with intercalary growth, many cells thick, parenchymatous and cells irregularly arranged                                                                                                                                                                                                | ..... 7                             |
| 6. Plants ribbon-like, regularly dichotomous with narrow angles of 15°-45° near the forks and long internodes, thallus 3-5 mm broad with entire and somewhat proliferous margins, three cells thick in sectional view, groups of hairs and reproductive structures scattered over the surface of the frond | ... <i>Dictyota dichotoma</i>       |
| 6. Plants fan-shaped, apical margin of the thallus rolled inward, hairs and reproductive structures arranged in concentric rings                                                                                                                                                                           | ... <i>Padina</i> (III)             |
| 7. Plants clathrate, spongy and net-like                                                                                                                                                                                                                                                                   | ... <i>Hydroclathrus clathratus</i> |
| 7. Plants not net-like or reticulate                                                                                                                                                                                                                                                                       | ..... 8                             |

- 8. Plants somewhat dichotomously branched with slightly compressed and solid axes, axes 2-3 mm broad ... *Chnoospora minima*
- 8. Plants tubular or hollow ..... 9
- 9. Plants sac-like, spherical or irregularly lobed with crisp texture, plurilocular sporangia associated with paraphyses ... *Colpomenia sinuosa*
- 9. Plants profusely and irregularly branched at the upper parts, branches compressed, 2-5 mm broad, sporangia not associated with paraphyses ... *Rosenvingea intricata*

I. Key to the Species of *Turbinaria*

- 1. Plants simple or moderately branched, leaves densely packed, arising all round the stem, rounded or somewhat triangular in surface view with marginal teeth ... *T. ornata*
- 1. Plants generously branched, leaves not closely arranged, triangular or heart-shaped with a cylindrical stalk ... *T. conoides*

II. Key to the Species of *Sargassum*

- 1. Inflorescence mixed with receptacles, leaves and vesicles ..... 2
- 1. Inflorescence not mixed with receptacles, air bladders and leaves ..... 3
- 2. Plants with fluted conical holdfast, leaves narrow (1.0-2.5 mm), linear, thick or fleshy with entire margin and blunt tips, vesicles oval or elliptic, receptacles simple or unbranched and somewhat spindle-shaped ... *S. johnstonii*
- 2. Plants delicate with a disc-shaped holdfast, leaves broad (3-5 mm), thin, translucent with somewhat dentate margins, vesicles spherical, receptacles single or branched and spinose ... *S. tenerrimum*
- 3. Stems and branches somewhat flattened with smooth surface, vesicles or bladders large, ellipsoidal or oval on flattened petioles of stalks ..... 4
- 3. Stems and branches densely covered with short processes or muricate, vesicles small, 1-2 mm broad and densely crowded, leaves 2 cm long and 0.5 cm broad below, smaller above with dentate margin, receptacles somewhat spinulose and very much ramified ... *S. myriocystum*
- 4. Receptacles in clusters, repeatedly branched with corymbose or tassel-shaped appearance ... *S. wightii*
- 4. Receptacles not repeatedly branched and not having tassel-like appearance ... *S. swartzii*

III. Key to the Species of *Padina*

- 1. Fructiferous organs found on both sides of a row of hairs, thallus usually four cells thick ... *P. tetrastromatica*
- 1. Fructiferous organs not found on both sides of the rows of hairs, thallus two to three cells thick ..... 2
- 2. Sporangia found just above the rows of hairs ... *P. commersonii*
- 2. Sporangia present at the central part of the thallus occurring in between the rows of hairs ... *P. gymnospora*

RED ALGAE

Key to the Genera and Species

- 1. Plants multicellular with one-cell thick and flat thallus, dark violet to mahogany-red in colour, cells with stellate contents, fronds with spinous margin ... *Porphyra vietnamensis*
- 1. Plants multicellular, the whole plant or parts of the plant consisting of a single row of cells .....2
- 1. Plants multicellular, the whole plant or parts of the plant many cells thick, often differentiated into a central medulla and outer cortex ..... 3
- 2. One-cell thick and branched filaments or trichoblasts present at the apical parts of the main axes and branches, thallus parenchymatous with uniform sized cells, tetrasporangia at the terminal portions of the branches or formed branchlets, immersed in the thallus ..... 4
- 2. Thallus with one cell thick main axis which is clearly visible in sectional view, covered with cortical cells, tetrasporangia formed at the nodes often in whorls, not immersed in the thallus .....5
- 4. Plants coarse with small and spinous branchlets alternately and spirally arranged, growing apex protruded, spermatangial clusters plate-like ... *Acanthophora spicifera*
- 4. Plants erect and bushy, more or less fleshy consistency, cylindrical or compressed, growing apex in sunken pits, antheridial clusters present in the enlarged apical pits of the fertile branchlets ... *Laurencia* (1)
- 5. Plants small 3-8 cm in height, filamentous, dichotomously branched, rhizoids one-cell thick, main axes completely covered by vertical rows of cortical cells, spines arranged in whorls at each segment ... *Centroceras clavulatum*

5. Plants 10-20 cm or more in height, irregularly and alternately branched, main axis and branches corticated, thickly covered by rhizoidal filaments, ultimate branchlets uniseriate or one-cell thick with small cortical bands at the nodes, internodes colourless, spines often present at the tips of branchlets ... *Spyridia* (II) .....
3. Medulla or central part of thallus filamentous ..... 6
3. Medulla cellular, not filamentous ..... 7
6. Plants small, entangled, dark or blackish red in colour, irregularly branched, with cylindrical axes, outer portion of thallus or cortex consisting of anticlinal branched rows of cells, tetrasporangia in sori or in groups ... *Gigartina acicularis* .....
6. Plants large, stellate or star-shaped cells present between the cortex and filamentous medulla, tetrasporangia not in sori but scattered in the cortex of the thallus ... .. 8
8. Plants firmly gelatinous, flat or cylindrical, pinnately or radially branched, cortex in sectional view consisting of small anticlinal rows of cells ... *Grateloupia* (III) .....
8. Plants large, flat, soft and gelatinous, rose-red in colour and pinnately branched, cortex parenchymatous, not arranged in regular rows ... *Halymania floresia* .....
7. Central axis clearly visible in the sectional view of mature thallus, plants irregularly branched in all directions, and abundantly covered with short branchlets or ramuli, terminal portions of the branches twisted as tendrils, tetrasporangia zonate ... *Hypnea musciformis* .....
7. Central axis not clearly visible in the sectional view of mature or fully grown fronds ..... 9
9. Thallus with a medulla of very small cells, cortical cells larger than the medullary cells, plants dichotomously branched, brick-red or yellowish-red in colour, tetrasporangia zonate ... *Sarconema furcellatum* .....
9. Medullary cells larger than the peripheral or cortical cells, ..... 10
10. Plants tufted, wiry, erect axes sparsely branched, provided with short determinate branchlets, 2-6 mm long, spirally or pinnately arranged, medulla with thick walled cells, 18-30 mm in diameter, tetrasporangia in swollen branchlets ... *Gelidiella acerosa* .....
10. Plants large, flat or cylindrical, with a medulla of large colourless cells 100-500 mm in diameter, tetrasporangia scattered in the cortex of the fronds ..... 11
11. Cystocarps with a parenchymatous gonimoblast surrounded by carpospores, nutritive filaments present connecting the gonimoblast tissue and the pericarp ... *Gracilaria* (IV) .....
11. Cystocarps with a mass of carpospores arising from thread-like structures, pericarp loose; plants up to 20 cm tall, di- or subdichotomously branched, 3-7 mm broad, proliferations arising from the basal parts of the thallus ... *Rhodymenia dissecta* .....

I. Key to the Species of *Laurencia*

- 1. Plants cartilaginous, firmly attached to rocks by a broad disc, main axes and branches densely covered by short wart-like branchlets, 2-4 mm broad, peripheral cells of the thallus radially elongated ... *L. papillosa*
- 1. Plants soft, attached by small discs or rhizoids, cylindrical and filiform, pinnately and multifariously branched, ultimate branchlets clavate, thallus 1-2 mm broad, peripheral cells not radially elongated ... *L. obtusa*

II. Key to the Species of *Spyridia*

- 1. Plants bushy, ramified on all sides with long and cylindrical branches, branches not constricted near the base ... *S. filamentosa*
- 1. Plants closely branched at the upper parts, articulate, main axes moniliform, lateral branches short, fusiform and very much constricted near the base ... *S. fusiformis*

III. Key to the Species of *Grateloupia*

- 1. Plants 10-25 cm tall, bushy with cylindrical and rarely compressed axes, pinnately, alternately and irregularly branched, fronds 2-3 mm compressed in diameter, filiform ... *G. filicina*
- 1. Plants 10-12 cm tall, firmly attached to rocks, thallus compressed, 0.25 to 1.0 cm broad, sinuate, simple and pinnately branched ... *G. lithophila*

IV. Key to the Species of *Gracilaria*

- 1. Plants compressed or flat .....2
- 1. Plants cylindrical .....3
- 2. Plants regularly dichotomous with thick and cartilaginous fronds, margins entire, rarely proliferous ... *G. corticata*
- 2. Plants polychotomously, irregularly and sometimes pinnately branched with thin and brittle fronds, margins proliferous ... *G. foliifera*
- 3. Plants small, succulent, sometimes constricted, branches upto 4.0 mm in diameter, arched and decumbent, developing haptera on reaching the substratum ... *G. crassa*
- 3. Plants not succulent, 30 cm or more in height, fronds thin, 2-3 mm in diameter .....4
- 4. Plants alternately, irregularly branched, branches hardly constricted, tetrasporangia surrounded by unmodified cortical cells ... *G. edulis*
- 4. Plants irregularly and multifariously branched, often grow up to 2.0 m in length, branches constricted below and tapering above, sometimes provided with short and spindle-shaped branchlets, tetrasporangia in slightly modified cortex, antheridia in deep cavities ... *G. verrucosa*



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